

THE MODE OF ACTION OF VENOM ACCORDING TO JĀḤIẒ

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Abū ‘Uthmān ‘Amr ibn Baḥr al-Jāḥiẓ (780-868) is a well-known Arabic man of letters who has made significant contributions to zoology as well.¹ In his numerous and voluminous writings he sought, very early in the history of Arabic thought, to reconcile science and theology. His main scientific work is *Kitāb al-Ḥayawān* (The Book of Animals), whose significance for the history of zoology has been studied at the end of the nineteenth century by G. van Vloten,² and, in this century, by M.A. Palacios and L. Kopf.³ In this short paper we will not, of course, be able to do justice to al-Jāḥiẓ’s entire work (the recent edition of the work comprises no less than seven volumes of almost 400 pages each⁴) and we will limit ourselves to a single *topos* studied in it: venoms and their mode of action. While being intent on avoiding a whiggish approach to the history of science, we will have to note that some of al-Jāḥiẓ’s ideas are reminiscent of modern toxicological ideas. We thus hope to make a contribution to the study of a chapter in the history of science of which our knowledge is still wanting.⁵

Our author lived during the period of the Abbassid caliphs (al-Rashīd, al-Ma’mūn and al-Mu‘taṣim) under whose reign the

¹ Charles Pellat, “Djāḥiẓ”, *Encyclopedia of Islam*, 2nd ed., vol. II (Leiden, 1965), pp. 385-7; Fuat Sezgin, *Geschichte des arabischen Schrifttums*, vol. III (Leiden, 1970), pp. 368-75; Manfred Ullmann, *Die Natur- und Geheimpwissenschaften im Islam* (Leiden, 1970), pp. 19-20.

² Sezgin, *Geschichte des arabischen Schrifttums*, p. 368 ff.

³ M.A. Palacios, “El Libro de los animales de Jāḥiẓ”, *Isis*, 14 (1930): 20-54; L. Kopf, “The Book of Animals (Kitāb al-Ḥayawān) of Al-Jāḥiẓ (ca. 767-868)”, *Actes du VII^e Congrès international d’histoire des sciences* (Jerusalem, 1953), pp. 395-401.

⁴ Jāḥiẓ, *Kitāb al-Ḥayawān*, edited and annotated by Abdessalām Mohammed Hārūn, 7 vols. (Beirut, 1988). In what follows all references to the *Kitāb al-Ḥayawān* are to this edition.

⁵ Jāḥiẓ’s reputation as an author of classical *adab* is perhaps the reason why his contributions to biological science have not been fully appreciated until now.

Arabo-Islamic civilization began to absorb and accommodate the Greek philosophical and scientific heritage, and he indeed was familiar with Aristotle's so-called *Book of Animals*.⁶ Still, his work is not in the Aristotelian tradition: according to van Vloten, Jāḥiẓ can be viewed as having developed, or expressed, an autochthonic, original "national zoology".⁷ Jāḥiẓ is thus interested in the history of Arabic thought on venoms and he tries to account for the familiarity with toxic substances among the early Arabs. In his *Kitāb al-Ḥayawān* Jāḥiẓ explains that Arabs, and nomads in general, have been interested in wild animals, and specifically in the venomous species:

As these peoples live in full nature and among wild beasts, they have often been victims of claws, bites and injections and sometimes were even devoured. Thus they needed to know in detail the nature and the behavior of each of these assailants, and by observation they have succeeded in finding various means of avoidance as well as finding a cure to heal their wounds. These nomads have increased their knowledge of the wild world throughout the centuries.⁸

I

Let us first present some theories bearing on venoms and their modes of actions that were current in al-Jāḥiẓ's time and of which he gives short accounts.

1. Indian scientists, Jāḥiẓ writes, hold that venom kills because it is a foreign body. According to them, all foreign bodies that penetrate an animal's body destroy it. According to Jāḥiẓ, this hypothesis had not been accepted by his contemporaries.⁹

Jāḥiẓ does not indicate the names of the Indian scientists to whom he refers. We suggest, however, that one of the scientists in question can be identified as Sānāq, an Indian physician who lived during the fourth century B.C.E., wrote about toxicology, and held precisely the idea described by Jāḥiẓ.¹⁰ We know that the great translation movement in Jāḥiẓ's time produced trans-

⁶ Ullmann, *Die Natur- und Geheimwissenschaften im Islam*, p. 20.

⁷ Sezgin, *Geschichte des arabischen Schrifttums*, p. 369.

⁸ Jāḥiẓ, *Kitāb al-Ḥayawān*, IV, 29.

⁹ *Ibid.*, IV, 319.

¹⁰ B. Strauss, "Das Giftbuch des Sanāq. Eine Litteraturgechichtliche Untersuchung", *Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin*, 4 (1935): 89-152.

lations not only of Greek, but also of Persian and Indian texts.¹¹ It is therefore not surprising to find that Jāhīz was acquainted with the writings of an Indian scholar.

2. Another explanation was offered by Abū Ishāq al-Nazzām, Jāhīz's teacher.¹² In his view, each body has its own proper venom, which, however, remains latent under normal conditions. The venom of snakes, for instance, is not deadly by itself; rather, it becomes mortal when it gets into contact with the victim's body: the intruding venom then prevents the inhibition of the latent power at work in the victim's own body, thereby causing the victim's death. This theory is in fact elaborated by al-Nazzām on the basis of his theory of *kumūn*.¹³

3. Another theory was propounded, according to Jāhīz, by Bakhtishū' ibn Jibrīl,¹⁴ a well-known physician of the caliph al-Ma'mūn. In his view, the venom is inoculated by the fangs of a snake, or the spur of a scorpion, which, he says, he observed to be hollow. He further believed that the viper inoculates its venom at the moment it reverses itself.

Bakhtishū' was obviously a keen observer, for his report is in conformity with what we know today of vipers. The venomous apparatus of the viper is endowed with a device consisting of a pair of fangs crossed by a small duct, completely closed, which is connected to the venom glands. In order to bite, the viper must open its jaws and make a strike downward so that its fangs reach the prey. Then the muscles in the mouth must contract: they thereby raise the upper mandible in order to sink the fangs in the prey, simultaneously compressing the venomous glands and injecting the venom violently.¹⁵ Taken together, these contractions appear like a reversal of the animal, as described by Bakhtishū'. This physician is thus the first to have gained interesting anatomical and behavioral insights into how snakes inoculate their venom. However, it was only in the seventeenth century that Francesco Redi provided conclusive evidence on the method of inoculation of venom used by snakes.¹⁶

¹¹ See Dimitri Gutas, *Greek Thought, Arabic Culture* (London and New York, 1998), pp. 24-5 and the references there.

¹² Jāhīz, *Kitāb al-Hayawān*, V, 21.

¹³ For a short introduction into the theory of *kumūn*, see *Encyclopaedia of Islam*, 2nd ed., vol. V (Leiden, 1986), pp. 384-5.

¹⁴ Jāhīz, *Kitāb al-Hayawān*, IV, 123-4.

¹⁵ R. Platel, *Zoologie*, 2 vols. (Paris, 1991), vol. II.

¹⁶ A. Ménez, "Les venins et toxines de serpents", in *La fonction venimeuse* (Paris, 1995), pp. 200-20.

II

After having sketched the various hypotheses on the mode of action of venoms discussed during in Jāḥiẓ's time, we will consider Jāḥiẓ's own views regarding this subject. Our author asserts that the question whether the venom will kill the prey depends on three factors:

1. The quantity (*kamm*) of venom necessary for obtaining a deadly effect. Jāḥiẓ reports an experiment in which a scorpion was weighed before and after it had injected its venom and which showed that the weight of the scorpion remained practically unchanged, allowing one to conclude that the quantity injected was so minute as to be unmeasurable. It should be remembered, however, that Diocles of Carystas, Aristotle's contemporary, already knew that a very small quantity of venom was enough to cause death.¹⁷

2. The process (*kayf*). Jāḥiẓ observes that the incision is necessary in order that the venom penetrate the body of the prey.

3. The kind or nature (*jins*) of the venom. Here Jāḥiẓ explains the various aspects determining the action of venom on the animal body (see below).

Using a terminology obviously inspired by Aristotle's logical writings, Jāḥiẓ has thus enumerated three necessary parameters determining whether, under given circumstances, a venom would have a mortal effect. It is impressive to note that the toxicity of a given poison in fact depends precisely on the three parameters mentioned by Jāḥiẓ: the efficiency of the mechanical inoculation device; the toxicity of the inoculated substance itself; and the minimal dose of venom capable of killing an animal.¹⁸

Jāḥiẓ addresses another issue that was debated in his time, *viz.* whether the spur or the fang were venomous in and by themselves, or rather were mere tools for the inoculation of the venom. Our author (erroneously) holds that both cases exist.¹⁹

¹⁷ A. Touwaide, "Galien et la toxicologie", in *Aufstieg und Niedergang der römischen Welt*, II, 37, 2 (Berlin, 1994), pp. 1887-1986, on pp. 1964-5.

¹⁸ P.-P. Grassé, *Précis de zoologie: Vertébrés*, 3 vols. (Paris, 1976), vol. I.

¹⁹ Jāḥiẓ, *Kitāb al-Ḥayawān*, IV, 125-6. We now know that neither the spurs nor fangs are venomous; rather they are only the device allowing the passage of the venom into the prey's body. See e.g. R. Stockmann and J. Heurtault, "Introduction", in *La fonction venimeuse*, pp. 1-11.

By contrast, Jāḥiẓ correctly affirms that the effect of the biting by e.g. a snake or a scorpion is not due to the incision of the spur or the fang; rather, it is due to the venom emitted during the biting, which acts either on the prey's blood, coagulating or liquefying it, or on the nerves.²⁰ It should again be remembered, however, that the difference between hemolytic and neurotoxic venom had already been known before Galen,²¹ so that Jāḥiẓ apparently expresses ideas he borrowed from Greek sources.

Concerning the mode of action of the venom, Jāḥiẓ rejects the explanations postulating heat as the cause of its morbid effect. In fact, since Aristotle it was generally held that heat plays an essential role in several essential physiological processes, notably in digestion and the formation of the homoeomeric substances (including blood, milk, etc.), and that illness occurs when this "mechanism" is disturbed.²² To refute this theory Jāḥiẓ writes:

If this inoculated element acted by its great heat, why then does fire not act in the same manner? And if it acted because of its very low heat, why then does ice not provoke the same effect? It is therefore clear that the venom does not kill because of its heat or its coldness.²³

Jāḥiẓ's view also runs counter another entrenched theory of his day. The accepted explanation of the physiology of venoms in classical Islamic medicine was based on the principle, going back to the Presocratic philosopher Anaximander and advocated in medicine by Alcmeon, according to which the four basic qualities of matter (heat, cold, humidity and dryness) must be in a state of balance if a body is to be healthy. Accordingly, contemporary pharmacology attributed to every substance, notably to any medicament, a degree to which it possessed any of the four qualities; the activity of any medicine was construed as depending on these degrees.²⁴ Jāḥiẓ implicitly rejects this theory and seeks to account for the activity of venoms through his own theory, which operates in terms of properties, specificities and the intrinsic nature of elements. According to this theory, it is

²⁰ Jāḥiẓ, *Kitāb al-Ḥayawān*, IV, 126.

²¹ Touwaide, "Galen et la toxicologie".

²² For an overview and bibliography see Gad Freudenthal, *Aristotle's Theory of Material Substance. Form and Soul, Heat and Pneuma* (Oxford, 1995).

²³ Jāḥiẓ, *Kitāb al-Ḥayawān*, IV, 318.

²⁴ As is well known, this classic theory received an innovative elaboration by al-Kindi, roughly Jāḥiẓ's contemporary. See Léon Gauthier, *Antécédents gréco-arabes de la psycho-physiologie* (Beirut, 1938).

the intrinsic nature of the venom that, by virtue of its specificity, possesses the property of provoking death in certain bodies. Put differently: a venom is not a venom *per se*, but rather has the property to act as such in certain bodies. These specificities, Jāḥiẓ claims, do not have names and can only be inferred from semantic structures. To illustrate his theory, our author compares the digestion of a dog with that of some herbivorous animals. He writes:

I am going to prove to you that what I just said on properties, specificities and the intrinsic nature of elements is true. Do you not see that in the stomach of a dog and a wolf, a bone is dissolved but not the stone of a date, although the latter is more tender than a bone? [...] Horses, which digest dry clovers and straw in dung, cannot digest grains of barley. Camels are capable of digesting hard and thorny vegetables, but cannot digest grains of barley. All of this can be explained only by properties and specificities.²⁵

III

Concerning the parameters determining the toxicity of a venom, Jāḥiẓ declares that it varies from one venomous species to another.²⁶ Among individuals belonging to the same species it depends on the following factors:

1. The injected quantity.²⁷ Jāḥiẓ, of course, had no means to determine empirically the quantity of venom inoculated in a given case. Still, he insightfully states that the individuals of a venomous species do not always inoculate the same quantity of venom. Furthermore, he emphasizes that venom can be effective only if a minimal dose of it had been inoculated.

2. The geographic region.²⁸ Jāḥiẓ holds that the effect of the venom of individuals belonging to a single species varies according to their geographical origin. Thus, he claims, the action of the venom of a species of scorpion called *jarrara* varies according to whether the individual is from the region of Chihrazor (in Kurdistan) or from the region of Askar Mokram (in Khuzistan). This statement seems to be grounded in observation. For instance, we know today that the species of scorpion *Buthus*

²⁵ Jāḥiẓ, *Kitāb al-Ḥayawān*, IV, 313.

²⁶ *Ibid.*, V, 363.

²⁷ *Ibid.*, IV, 319.

²⁸ *Ibid.*, V, 363.

occitanus is not venomous in Europe, while in North Africa this scorpion is very dangerous to men.²⁹

3. The physiological state of the venomous animal.³⁰ Speaking of scorpions, Jāhiz notes that the gravity of the consequences of an inoculation varies according to whether it occurs when the scorpion stings for the first time after hibernation or not. In addition, it differs according to whether the scorpion is in a state of gestation or not.

4. Similarly, Jāhiz mentions that the injury caused by the venom varies from one prey to another.³¹ Concerning the same bitten or stung individual, the toxic effect depends of the following factors:

(i) The place on the body.³²

(ii) The physiological state of the prey.³³ The injury caused differs according to what nourishment the victim had absorbed and according to its respiratory state.

(iii) The time of the day.³⁴ The action of venom depends also on whether the inoculation occurs during day or night. As evidence, Jāhiz adduces the alleged fact that people feel more pain after inoculation at night than at day. The venom's action also varies with the seasons, being more painful in summer than in winter. This assertion is grounded in the view that the action of venom depends on a further factor, namely:

(iv) The heat.³⁵ Jāhiz reports that people believe that inoculation by a scorpion is more painful to someone who had just taken a bath in warm water. Elaborating upon the explanation given by his master, Abū Ishāq al-Nazzām, to the supposed increased efficiency of venom when it is hot, Jāhiz claims that the phenomenon is due to the fact that increased bodily heat brings about an opening of the bodily pores and a dilation of the blood vessels. This, he argues, is also the reason why the venom of scorpions is more powerful in summer: the hotter the air, the greater the likelihood that the body will heat itself, and the more painful will the venom be. Our author uses the same theoretical

²⁹ G.G. Habermehl, *Venomous Animals and their Toxins* (Berlin, 1981), p. 23 and table 4.

³⁰ Jāhiz, *Kitāb al-Ḥayawān*, V, 363.

³¹ *Ibid.*, IV, 221-2.

³² *Ibid.*, V, 363.

³³ *Ibid.*, V, 363.

³⁴ *Ibid.*, V, 363.

³⁵ *Ibid.*, IV, 222.

construction to explain why people feel far more pain at night, although the air is then colder than during day. On the basis of the general physiological theoretical assumptions of his day, Jāḥiẓ argues that when the ambient air is cold, the heat “escapes” into the interior of the body, which is thus hotter than it would have been otherwise; it follows that an inoculation is more painful at night.

(v) The psychological state of the victim.³⁶ A last factor influencing the efficiency of venom as explained by our author is the psychological state of the victim, specifically of a person bitten by a snake, which can play a decisive role in the outcome of the inoculation. Jāḥiẓ states that there are snakes whose venom is mortal only if it is associated with the fright of the victim. Sometimes, he declares, it is fright alone that kills the victim. In order to illustrate this phenomenon, Jāḥiẓ recounts an anecdote of a man who had been bitten in his head by a snake while he slept under a tree. The bite woke him up, but he did not immediately realize what had happened. The man remained conscious, until a bystander who had observed the scene told him that he had been bitten by a snake. Thereupon the frightened man cried out and quickly died. According to our author, the effect of the venom on vital organs had at first been inhibited, but then the fright nullified this inhibitory factor. Jāḥiẓ tries to explain how the combined action of these two factors operates in the body. He writes:

Fright can either direct the venom to vital places, or act together with the venom [in order to efficiently lead this toxic substance to vital organs].³⁷

Jāḥiẓ concludes that fright must be taken into account if one wishes to explain the action of venom in causing death. He argues that it is misguided to say of a given venom that it is mortal without reference to the psychological state of the victim. One can make such a statement only in cases where the venom acts on people who are shielded from fright, e.g. a person who was bitten without being aware of it (because he slept or fainted, for example), a naive child, or an insane person. Jāḥiẓ is thus the first author who has drawn attention to the psychological dimension of the efficiency of the action of venom.

³⁶ *Ibid.*, IV, 121-3.

³⁷ *Ibid.*, IV, 123.

IV

Jāḥiẓ mentions also further physiological aspects of the action of venom. We will limit ourselves to two examples: The passage of the venom from the blood to the maternal milk; and the possibility to avert the danger after inoculation by sucking the blood out of the wound.

Jāḥiẓ mentions the case of a camel that was bitten by a venomous snake while it suckled its young.³⁸ At first, the camel remained upright, and the young continued to suck. Then, suddenly, the young fell dead, while the mother still remained alive for a short while. Jāḥiẓ expressed his astonishment with respect to the observed rapidity of the passage of the venom to the maternal milk. He went on to infer that a woman who drinks wine while breastfeeding thereby intoxicates the baby. By the same token, he remarks that a breastfeeding mother can provoke diarrhea in the baby by taking a laxative.

Jāḥiẓ reports that when somebody was stung by a scorpion, the *ḥajjām*, a person specialized in sucking venom out of a sting wound, was called in order to suck the poisoned blood at the place of the injection before the venom spread throughout the body of the victim.³⁹ Jāḥiẓ noticed that this practice caused health problems for the *ḥajjām*, because his mouth was in direct contact with the poisoned blood. To avoid these problems, a piece of cotton was put on the place of the injection before aspirating. The cotton thus prevented the passage of the blood to the *ḥajjām*'s mouth, yet without constricting his aspiration.

CONCLUSION

In the poems of the great Bedouin writers before the advent of Islam, poison was often mentioned, but no differentiation in the terminology is discernible.⁴⁰ Subsequently, classical Islamic culture has produced many books on toxicology, as it was a part of medicine, but Jāḥiẓ seems to have been one of the first Arabic writers to have treated this subject-matter in the framework of

³⁸ *Ibid.*, V, 366-7.

³⁹ *Ibid.*, IV, 219-20.

⁴⁰ M. Ullmann, *Die Medizin im Islam* (Leiden, 1970), p. 322.

rational, empirical science. In the light of the above gleanings into his work in toxicology, it can be stated that Jāḥiẓ is probably the first Arab naturalist to have undertaken a complete study on venoms and their modes of action. It is important to note that his theoretical insights concerning venoms are not all his own. Rather, as Jāḥiẓ himself emphasizes, they are the product of a progressive process of accumulation of knowledge, by both scholars and laymen who had to deal with poisons in daily life. In Jāḥiẓ's theoretical synthesis one finds, in addition to Greek and Indian influences, his personal views together with those of contemporary scholars. His originality is above all expressed in his theory of properties, specificities and the intrinsic natures of the elements, which accounts for various mechanisms of the digestion and the mode of action of venom.⁴¹

This theory, let us note, takes a path very different from the one exposed in another (probably later) influential treatise on toxicology, namely the *Kitāb al-sumūm wa daf' maḍārrihā* of Jābir ibn Ḥayyān.⁴² This book, which was presumably written in the late ninth or the early the tenth century, provides a description of different poisons of animal, plant and mineral origin, of their modes of actions and of the different treatments of poisonings. The theoretical physiology on which Jābir draws is of the well-known humoral type, inherited from classical Greek medicine, which explains the action of poisons either as their being inflammation and burning (*ilhāb wa iḥrāq*) or as being stiffening and coldness (*ijmād wa tabrīd*).⁴³ Although the question of the historical relationship between Jāḥiẓ and Jābir needs further research, it is important to note that Jāḥiẓ opposed precisely the kind of theories advocated by Jābir.

We can only be impressed by the number of factors potentially influencing the gravity of the action of venom which Jāḥiẓ pointed out. (He may have become attentive to them inasmuch as these various parameters determined the difficulties in successfully treating victims.) It is particularly interesting to note

⁴¹ Although it would be ridiculous to draw any comparison between Jāḥiẓ's ideas and those of modern biology, one cannot help being struck by the similarity between the theory of specificities and present-day knowledge regarding the specific actions of enzymes.

⁴² *Das Buch der Gifte des Gābir ibn Ḥayyān*, übersetzt und erläutert von Alfred Siggel (Wiesbaden 1958).

⁴³ Ullmann, *Die Medizin im Islam*, pp. 327-8 and *Gābir ibn Ḥayyān*, ed. Siggel, pp. 7-9.

that our author is most likely the first to have noticed the psychological dimension in the action of venom.

Jāḥiẓ's *Kitāb al-Ḥayawān* is of considerable interest also as a source of knowledge for the history of toxicology. Jāḥiẓ provides us with valuable information on scientific discussions going on during his time, and particularly on some scholars active in the 8/9th century, such as Bakhtīshū' ibn Jibrīl and Abū Ishāq al-Naẓẓām. Jāḥiẓ was an active participant in these discussions, and thereby contributed to the scientific development of his period.*

* We are indebted H. Larson for the English translation of this paper and to the editors of *Arabic Sciences and Philosophy* for their thorough redaction.